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SIMPLE DEVICES FOR DEVELOPMENT PLANNING

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1. INTRODUCTORY

In this paper we propose to list a number of devices for the construction of a development plan. Together they are a complete set of activities to arrive at such a plan. They do not represent the most sophisticated methods known to the author but rather the most practical ones. Their selection necessarily remains somewhat arbitrary and depends on the author's taste. The resulting method of planning is one of successive approximations and not a simultaneous solution of the complete set of interrelated problems which a plan must solve. Each of the following sections may be considered a phase or a stage of the process. It is in the nature of successive approximations that some of the phases must be repeated if the assumptions used are disqualified by later findings. Some of the data to be used may themselves be the outcome of pieces of "partial research" which can be undertaken independently from the succession of phases.

As a rule, development plans will be based on the assumption that prices do not change. In some cases this may not be a permissible simplification; something will be said about it in section 6.

2. MACRO-ECONOMIC ESTIMATES

To begin with, estimates are made on the most desirable time path of total national product or income $\underline{y}_t$, total savings $\underline{s}_t$ and total investment $\underline{j}_t$. We assume that these figures are known for a base year $\underline{t} = 0$. The difference between j_t and s_t represents net foreign aid $\underline{f}_t$; we assume that it is known for the planning period. The essence of our problem consists of finding the optimum level of $\underline{s}_t$ or the optimum level of the savings ratio $\sigma_t = \frac{s_t}{y_t}$.

Both may vary over time. The optimum path must be such that at no moment is it desirable to save more or to save less. In order to judge this we must

(i) know its consequences and

(ii) have a yardstick to evaluate these consequences.

The consequences of increased savings are a larger volume of capital $\underline{K}_t$, resulting in a larger volume of production, both for all future. It is doubtful by how much future production will be raised if 1 per cent more of national income is saved in any given year. The simplest theory so far proposed is the one of the constant capital-output ratio. This theory

maintains that each addition to the capital stock leads to a proportional addition to national product. The proportionality factor is about 3 or 4 (if a time unit of a year is used) for most countries. For countries using considerable amounts of foreign capital the capital-output ratio may be considerably higher than otherwise would have been the case: the net product added to their national product will be lower than the product obtained from an investment by the amount of interest to be paid to foreign investors.

More refined theories are those using production functions. A wellknown example is the Cobb-Douglas function. It shows less than proportional increases in production; a 1 per cent increase in capital works out into a 1/4 per cent increase in production only. The wide divergence between these two figures may be interpreted as follows. In the theory mentioned first the tacid assumption is made that technical and organization progress as well as education develop in proportion to the rise in capital. If this assumption is kept in mind during the further elaboration of the plan, the use of constant capital-output ratios can be accepted. This means that education and technical progress etc. are planned in appropriate proportions.

A simple example may show the practical use of the assumptions just discussed. Let the capital-output ratio be 3 years and the savings and investment ratios in the base year 8 and 12 per cent of national income, implying foreign aid to the extent of 4 per cent. Let it be expected that foreign aid remains at this level. The rate of increase in income, according to our assumptions, will be 4 per cent ($\frac{12}{3}$) in the beginning. If the savings ratio were raised to 11 per cent, income would rise by 5 per cent annually; but in the first year consumption would have to fall by 3 per cent (11 minus 8). Similarly, more alternatives can be calculated, as indicated in the following table (expressed in per cent of national income):

Table 2.1.

Characteristics of Alternative Paths of Growth

Rate of savings	Annual rise in income	Initial fall in consumption
8	4	0
11	5	3
14	6	6

In order to make a choice the government must evaluate the consequences indicated above. It is the author's contention that at the moment economic science is not able to guide governments in this choice. Insufficient knowledge is available about the preferences of the population; moreover, the government as well as parliament may wish to deviate deliberately from these preferences if they consider the average citizen less farsighted than seems to be his own long-term interest.

We therefore assume that a choice is made by the government and that, as a consequence, the future development of investment, consumption and income is given.

Our example is oversimplified, in that it suggests a constant savings ratio and a constant rate of increase in income over time. The planning agency may make estimates with varying rates. In all probability the rate of increase in income will not be forthcoming immediately, since investments require time. If the gestation period is three years, the increases in income corresponding with higher savings in year 1 will only show up from year 4 on. This feature can be introduced fairly easily into our estimates.

3. SECTOR PLANNING

The next set of problems to be considered refers to the prospective development of demand in a number of sectors. First of all the sectors must be defined. Their number should not be too large; about twenty may be a good figure. The sectors should be as homogeneous as possible and it is clear that their choice depends on the structure of the country. Some sectors may be chosen because of their possible future importance. One sector may be non-competing imports. Once the sectors have been chosen, all data should be subdivided accordingly.

We start by estimating future demand for finished goods; these may be consumer, investment or export goods.

Consumer demand is estimated from the planned development of income and from expected population figures. Average income per head can be estimated and knowledge on Engel curves will enable us to estimate average demand per head for individual commodities or groups of them. By means of multiplication by population total demand for these groups of commodities can be obtained. A more refined approach consists of using the income distribution. In this case we must not only know the income distribution in the base year, but also the changes to be expected in it. One possibility is to assume that all income intervals will expand proportionately to average income. The method of estimating average demand for a given group of commodities can now be used for each income bracket. Thus a more precise estimate of total demand is possible. For commodities showing a non-linear Engel curve this estimate is better. For commodities with a linear Engel curve the previous method is just as good.

If no family budget statistics are available for the country concerned, figures for comparable countries may be used. Alongside income other factors will sometimes influence demand. In same cases trends may have to be added representing changes in tastes or technological improvements.

Demand for investment goods was estimated as one figure (for each year) in the macro-economic approach already. It can be subdivided into demand for, say, buildings, for equipment and for increases in stocks, if we have some initial figures and assume proportional increases. We will discuss a second (better) approximation below.

Export demand may be estimated with the aid of the principles used for estimating consumer demand. Incomes must now be incomes of countries absorbing exports. Since export commodities will not as a rule be finished consumer goods, the relationship between income and demand must be found from other sources than family budget figures.

Having estimated the demand for finished goods we can now estimate the necessary development of production of intermediate goods and raw materials, as far as specified by our sector definitions; they are supposed to be outputs of some sector. Their production is estimated with the aid of input-output coefficients. Demand for finished goods is considered the "final bill of goods" and the result of the operation will be the production programme needed, with the existing structure, to provide for this final bill of goods. It is not certain that the existing structure should be maintained. It may be desirable to develop more rapidly some industries showing comparative advantages; and to develop less rapidly some industries showing comparative disadvantages. For the time being it is assumed that the existing pattern was chosen in line with comparative advantages. In the project appraisal phase the pattern will be checked and a change may be suggested by it.

The sector-wise production programme just derived may now be used to estimate a second approximation of the investment programme, based on sectoral investment programmes. In order to carry this out we must know, for each sector, the capital-output ration and the gestation period characteristic for it. The desired increase in production in all sectors can then be translated into an investment programme. This will not, as a general rule, coincide with the one calculated before. In order for it to coincide the average capital output ratio and the average gestation period used in the first approximation would just have to be equal to the properly weighted averages of the sectoral capital output ratios and gestation periods. Proper weights are those corresponding with the relative increases in production of the various sectors.

Among the sectors considered we may also include some educational and other social activities. This enables us to integrate into the plan a plan for training the necessary manpower of all levels. The necessary inputs are buildings and further equipment as well as teachers, themselves an output of some educational institutions. One of the important characteristics of the educational sectors is the long duration of the process. It may well be therefore that education becomes a bottle-neck to the development process, unless imports of trained manpower are considered possible. The necessary imports can then be estimated.

As a rule the outcome of the sector estimates will constitute a check on the figures estimated in the macro phase. It will be necessary to repeat the calculations of both the macro and the sector phase whenever considerable discrepancies occur. This may be an inefficient procedure but it is my belief that it is not. In some simplified cases I think it can be proved that this "planning in stages" is an efficient approach[1]

Among the sectors a number will be producing "national goods", that is, goods which cannot be exported or imported. Important examples are energy, inland transportation, building, retail and wholesale trade, and a number of services. The production estimates obtained for these sectors can be considered final. Whatever changes in structure will be considered later must be changes in "international sectors", producing goods which can be imported or exported. Such switches are not possible in national sectors.

There may even be scope in introducing the concept of "regional sectors", producing goods which cannot be imported into or exported from the regions where they are needed. As soon as a plan has to be specified for regions -- meant here to be parts of a nation -- this concept becomes relevant. It depends on the aims of economic development policies what use can be made of the concept. If these aims imply the fixation, beforehand, of income aims for the various regions, the necessary production of regional goods can be estimated directly, before even the distribution of interregional sectors over the regions is fixed. It is true that this is an approximation only; strictly speaking the need for regional products may depend on the industry mix of the region. As a first approximation, however, this need may be assumed to depend on total income (or production) only.

4. PROJECT APPRAISAL

The heart of development programming consists of the appraisal of individual projects and to select those to be included in the programme or plan. The bulk of the work involved is of a technological character: the preparation of figures describing the inputs and outputs of each project, both during

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1) J. Tinbergen, "Planning in Stages", Statsøkonomisk Tidsskrift, (1962) p.1.

the investment period an during the operation period. In principle these figures must describe all the "relevant" features, that is the contributions made to the aims of development policy and the use made of the country's scarce resources. Since the main aims usually are economic ones the economic aspects of the projects usually rank high; but several extra-economic aspects are also important, such as the project's contribution to employment, to income distribution among groups of the population and among regions, to education, to health and to the cultural level of the country. Some of these aspects cannot be measured or estimated and may be judged intuitively only. The methods of appraisal to be used have been developed mostly by economists, but their applicability is much more general and it is an error to think that they are imposing economic criteria on extra-economic aspects. They are the only logical way of solving a problem of choice, wherever it comes up. Of course they may be subject to improvement. A prerequisite of making a development plan is the existence of a sufficient stock of projects, in the public as well as in the private sector, sufficiently detailed to be carried out when necessary. The preparation of such a stock is an integral part of the total task of planning.

The first question to be dealt with is the one of the most appropriate "unit" or "building block" to be used in the exercise. Although we suggested, in what preceded, that it is the single project in the practical sense of that word, we think it is better to consider as the unit of appraisal something more complex, expressing the necessary complementarities involved. Our building blocks of the programme to be selected consist, each of them, of one project in an international sector plus a set of complementary investments in the national sectors. An example will clarify matters.

Let the project in an international sector be a weaving factory. For its operation this factory will need energy transportation, building, and some services which must be available and which cannot be imported. Productive capacity in these national sectors must be expanded simultaneously with the creation of the weaving unit. We will call these additions to capacity the complementary set of investments in national sectors. Its estimation will be discussed below. Before doing so we must emphasize that the complementarity just discussed does not exist with regard to any inputs from international sectors needed: these inputs can always be imported. It is not true, for example, that the establishment of a weaving unit also requires the establishment of a spinning factory: the necessary yarn may be imported. The possible international-sector investments should therefore all be considered separately in order to find out which of them shows comparative advantages and which does not show them. But each of them should be combined with the complementary set of investments in national sectors.

The next question is the criterion to be used. Many criteria have been proposed by the many writers on the subject. Practically all of them can be brought under the general formula of a fraction. The numerator of this fraction expresses the value of the contributions to the aims of national development policy. The denominator expresses the value of the scarce factors used. It is customary to include in the denominator only the value of the factors used during the investment period and not those during the operation period. The latter will then be brought in as negative contributions in the numerator. It would be possible to put them into the denominator. We will stick to the customary method here. The simplest case conceivable shows only one term in both the numerator and the denominator, for instance the contribution to national income in the former and the capital invested in the latter. This is correct if the only aim of development policy is raising the national income and the only scarce factor is capital. If there is another aim, for instance, to increase employment, the numerator should be the "value" sum of the two aims. This presupposes

that we can attribute relative prices to the aims. Thes prices may be obtained from interviews with policy-makers. In principle they can also be considered as marginal (social) utilities of the aim variables. From the economist's point of view they are autonomous or exogenous; this illustrates the acceptance, by the economist, of extra-economic elements in policy aims.

If there are more than one scarce factor, a similar problem turns up. Alongside capital, such factors as foreign exchange or trained labour may also be scarce. Their total value in the denominator can only be calculated if we have prices. These prices cannot be considered autonomous, however, They must be so as to equilibrate demand and supply. If the markets considered are in equilibrium the observed prices (market prices) may be used. If the markets are not in equilibrium, fictitious prices must be used, known as accounting prices or shadow prices. Under some circumstances these prices can be estimated fairly accurately. The price of an imported input which is protected by an import duty should be taken equal to the world market price. If all the investment projects and the factors needed for them are known, the shadow prices can be found by trail and error methods aiming at

(a) using all of the available scarce factors, and
(b) maximizing the contribution to the aims [2].

In other cases crude estimates of shadow prices can only be made. There are strong arguments to apply a low shadow price for unskilled labour.

Shadow prices for factors may also have to be used in the estimation of the contribution to national income of a project. If among the aims balance of payments equilibrium is chosen, the price to be used for a given improvement in the balance of payments may be taken equal to the shadow price for foreign exchange. Here the price would, then, not be autonomous -- unless this aim were considered to have an extra-economic value apart from its economic significance.

Both the contributions to the aims and the scarce factors used should be estimated for a future period, in principle the period of the project's life time. This implies that the quantities and the prices used need not be equal to those prevailing at the moment of appraisal. The quantities of inputs may diminish as a consequence of a learning process. The prices may change as a consequence of changed scarcity conditions.

On the list of projects to choose from we may not only have alternative projects, but also alternative versions of what is essentially the same project. These alternative versions may differ in the technologies used either for the operation phase or for the investment phase. The different techniques may be characterized by their capital intensities, that is, quantities of capital used per man employed. In some production processes considerable ranges of variation for capital intensity exist and a proper choice may be important especially if heavy weight is given to employment as an objective. The choice just indicated may sometimes be made as a separate "partial" study, if it is likely to depend only slightly on the precise outcome of the appraisal of other projects.

The use to be made of the criterion described is to select the projects yielding the highest values of it, except for some forms of regional policy to be discussed in the next section. This raises the question where

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2) The problems to be solved are related to but not identical with linear programming problems. For applications of linear programming to this field see H.B. Chenery and P.G. Clark, Interindustry Economics, New York 1959, especially p. 123 f.f. and p. 283 f.f.

to stop. As a rule the volume of investment will be the figure determining the frontier between projects included in the programme and projects not included. A problem arises, however, when the marginal project chosen in this way makes a negative contribution to the aims. A simple example is presented by the case in which a negative contribution to national income would be made. Such a situation indicates that there is something wrong with the general economic situation of the country considered; in a general way it indicates that incomes paid are higher than "the country can afford". Such a conclusion can only be drawn after a sufficiently large number of projects has been traced and appraised. The conclusion is of considerable importance to the development policy of the country.

5. REGIONAL PROGRAMMES

Sometimes not only a programme for the country at large is required, but also programmes for the geographical subdivisions of the country, to be named "regions". This introduces a new dimension into the problems, that of distance and location. In its full consequences this new dimension will make the problems so much more complicated that we cannot hope to solve them in a precise way. The necessary data as well as the necessary theories are lacking. In this essay only the simplest devices will be discussed which must be introduced in order to arrive at regional programmes consistent with regard to some main criteria. Similarly to what is needed for a national plan, we must also now know the aims of the regional development policy. Usually, if we speak of a regional policy, some extra-economic aims will be on the minds of the policy-makers. Well-known examples of such aims are the reduction in the differences in income per head or unemployment between the regions. This implies that more investments will have to be made in regions showing low incomes or high unemployment, even if the most attractive projects from the national point of view are not to be found in those regions. The simplest way in which we can now proceed is the following. We make a distinction between "shiftable" and "non-shiftable" projects. The former can be carried out in several if not all, regions, without changing their contribution to national aims. The latter can only be carried out in one region (or a few regions). Each project in an international industry (with the complementary sets of investments in national industries) must now be given a set of "numbers" indicating the regions in which this project or parts of it can be carried out. The selection of projects for inclusion in the development programme will now be different from what it was in section 4. Instead of taking first what from a national point of view was the "best" project, then the second best, and so on, we select now from the projects carrying the number of the region most in need of development only. The first project to be picked now will be the best among those carrying the number of the particular region. The second project will be the second best again among the projects carrying that same number, and so on. When, as a consequence of the projects selected, the region considered has been brought to the level of the next poorest region picking will be from projects situated in both regions. When both have been lifted to the level of the next poorest (third) region, we go on taking in projects of the three regions -- in proportions keeping them at the same level. In this way we go on until we have fully used the investible funds available. It will be understood that a large number of variations are conceivable with regard to the criteria used for the needs of the regions, and the degree to which these needs have to be taken into account.

The project selection described in the preceding and the present section must be considered as a correction of the sector estimates discussed in section 3. Sectors showing comparative advantages in production cost in the sense of the theory of international trade will appear to have been expanded

more than sectors showing comparative disadvantages. Some of the calculations based on the sector approach, as, for instance, the needs for education, will have to be revised accordingly. The same applies to the refined calculation of investments, including their timing. This again illustrates the trial-and-error character of our method. Strictly speaking, trial and error methods are only correct when they lead to a converging series of estimates This is not necessarily always true. Additional theoretical research will be needed to show the character of the series of estimates. Sometimes a choice exists between different methods of adaptation some of which are rapidly converging[3]. These may be useful if the total amount of work has to be kept within reasonable limits, but they are not always the best methods from the economy's point of view.

6. ASSUMPTION ABOUT PRICES

It was already observed in section 1 that prices are as a rule supposed to remain constant. It may be said to be the very aim of planning to maintain equilibrium and hence to avoid the necessity of changing prices. There are cases where this assumption is not permitted. Plans may then have to be based on changes in prices. This applies, first of all, to external changes, that is, changes in world market prices as a consequence of external developments. These must be estimated as accurately as possible from pure forecasts, as distinct from plans. Changes in prices may also be necessary as a consequence of some features of the plan. This may be so if exports are increased of a product in which the country has comparative advantages and serves a considerable portion of the world market. The price change must then be functionally related to the rise in exports with the aid of a world demand function. As a consequence of these price changes national income will also be affected and all demand functions depending on it. It is not too difficult to introduce such changes into the formulae of our procedures[4].

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3) Cf. Herbert S. Levine, "The Centralized Planning of Supply in Soviet Industry", Joint Economic Committee, Congress of the United States, Comparisons of the United States and Soviet Economics, Part I, Washington, 1959.

4) Cf. H.C. Bos and J. Tinbergen, Mathematical Models of Economic Growth, chapter 6, New York, 1962.

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